

T-51-11

CD4016A Types

CMOS Quad Bilateral Switch

For Transmission or Multiplexing of Analog or Digital Signals

The RCA-CD4016A Series types are quad bilateral switches intended for the transmission or multiplexing of analog or digital signals. Each of the four independent bilateral switches has a single control signal input which simultaneously biases both the p and n device in a given switch ON or OFF. These types are supplied in 14-lead hermetic dual-in-line ceramic packages (D and F suffixes), 14-lead dual-in-line plastic packages (E suffix), 14-lead ceramic flat packages (K suffix), and in chip form (H suffix).

Features:

- 15-V digital or ± 7.5-V peak-to-peak switching
- 280-Ω typical ON resistance for 15-V operation
- Switch ON resistance matched to within 10 Ω typ. over 15-V signal-input range
- High ON/OFF output-voltage ratio: 65 dB typ. @ $f_{is} = 10$ kHz, $R_L = 10$ kΩ

- High degree of linearity: <0.5% distortion typ. @ $f_{is} = 1$ kHz, $V_{is} = 5$ V_{p-p}, $V_{DD} - V_{SS} \geq 10$ V, $R_L = 10$ kΩ
- Extremely low OFF switch leakage resulting in very low offset current and high effective OFF resistance: 100 pA typ. @ $V_{DD} - V_{SS} = 10$ V, $T_A = 25^\circ\text{C}$
- Extremely high control input impedance (control circuit isolated from signal circuit: 10¹² Ω typ.)
- Low crosstalk between switches: -50 dB typ. @ $f_{is} = 0.9$ MHz, $R_L = 1$ kΩ
- Matched control-input to signal-output capacitance: Reduces output signal transients
- Frequency response, switch ON = 40 MHz (typ.)
- Quiescent current specified to 15 V
- Maximum input leakage current of 1 μA at 15 V (full package-temperature range)

Applications:

- Analog signal switching/multiplexing
- Signal gating
- Squelch control
- Chopper
- Modulator
- Demodulator
- Commutating switch

RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following range:

CHARACTERISTIC	LIMITS		UNITS
	Min.	Max.	
Supply Voltage Range (For $T_A =$ Full Package Temperature Range)	3	12	V

TYPICAL "ON" RESISTANCE CHARACTERISTICS

CHARACTERISTIC	SUPPLY CONDITIONS		LOAD CONDITIONS					
	V_{DD} (V)	V_{SS} (V)	$R_L = 1k\Omega$		$R_L = 10k\Omega$		$R_L = 100k\Omega$	
			VALUE (Ω)	V_{is} (V)	VALUE (Ω)	V_{is} (V)	VALUE (Ω)	V_{is} (V)
R_{ON}	15	0	200	15	200	15	180	15
$R_{ON(max)}$	15	0	300	11	300	9.3	320	9.2
R_{ON}	10	0	290	10	250	10	240	10
$R_{ON(max)}$	10	0	500	7.4	560	5.6	610	5.5
R_{ON}	5	0	860	5	470	5	450	5
$R_{ON(max)}$	5	0	1.7k	4.2	7k	2.9	33k	2.7
R_{ON}	7.5	-7.5	200	7.5	200	7.5	180	7.5
$R_{ON(max)}$	7.5	-7.5	290	0.25	280	25	400	0.25
R_{ON}	5	-5	260	5	250	5	240	5
$R_{ON(max)}$	5	-5	310	5	250	5	240	5
R_{ON}	5	-5	600	0.25	580	0.25	760	0.25
R_{ON}	2.5	-2.5	590	2.5	450	2.5	490	2.5
$R_{ON(max)}$	2.5	-2.5	720	2.5	520	2.5	520	2.5
R_{ON}	-2.5	-2.5	232k	0.25	300k	0.25	870k	0.25

* Variation from a perfect switch, $R_{ON} = 0\Omega$.

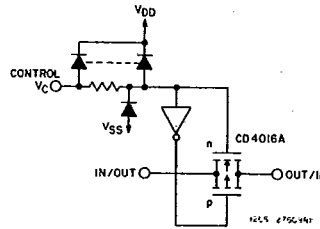
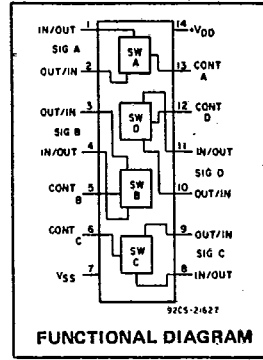


Fig. 1—Schematic diagram — 1 of 4 identical sections.

- Digital signal switching/multiplexing
- CMOS logic implementation
- Analog-to-digital & digital-to-analog conversion
- Digital control of frequency, impedance, phase, and analog-signal gain

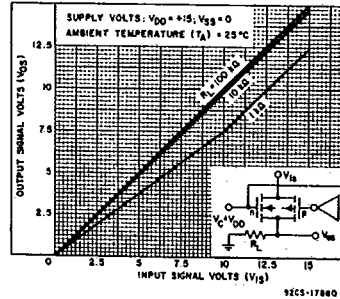


Fig. 2 — Typ. "ON" characteristics for 1 of 4 switches with $V_{DD} = +15$ V, $V_{SS} = 0$ V.

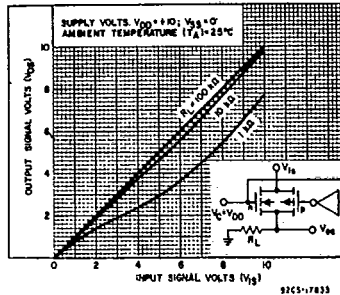


Fig. 3 — Typ. "ON" characteristics for 1 of 4 switches with $V_{DD} = +10$ V, $V_{SS} = 0$ V.

CD4016A Types

ELECTRICAL CHARACTERISTICS (All inputs. $V_{SS} \leq V_I \leq V_{DD}$)
Recommended DC Supply Voltage ($V_{DD}-V_{SS}$) . . . 3 to 15 V)

Characteristic	Test Conditions All Voltage Values are in Volts	Limits						Unit	
		Values at -55°C, +25°C, +125°C Apply to D, F, K, H Packages Values at -40°C, +25°C, +85°C Apply to E Package							
		V _{DD} (V)	-55°	-40°	+85°	+125°	+25°C		
					Typ.	Max.			
Quiescent Device Current, I _L max (All switches ON or all Switches OFF) D, F, H Pkgs		5	0.25	-	-	10	0.01	0.25	μA
		10	0.5	-	-	20	0.01	0.5	
		15	2	-	-	40	0.01	2	
E, Y Pkgs		5	-	0.25	5	-	-	0.25	μA
		10	-	0.5	10	-	-	0.5	
		15	-	2	20	-	-	2	

Signal Inputs (V _{IS}) and Outputs (V _{OS})											
Characteristic	V _C = V _{DD}	V _{SS}	V _{IS}	Typ/Max	Typ/Max	Typ/Max	Typ/Max				
	R _L = 10 kΩ*										
ON Resistance, RON	+7.5	-7.5	+7.5	120/360	130/370	260/520	300/600	200	400	Ω	
			-7.5	120/360	130/370	260/520	300/600	200	400		
			±0.25	130/775	160/790	400/1080	470/1230	280	850		
		+5	-5	+5	130/600	150/610	340/840	400/960	250		660
				-5	130/600	150/610	340/840	400/960	250		660
				±0.25	325/1870	370/1900	770/2380	900/2600	580		2000
	+15	0	+15	120/360	130/370	260/520	300/600	200	400		
			±0.25	120/360	130/370	260/520	300/600	200	400		
			+9.3	150/775	180/790	400/1080	490/1230	300	850		
		+10	0	+10	130/600	150/610	340/840	400/960	250	660	
				±0.25	130/600	150/610	340/840	400/960	250	660	
				+5.6	300/1870	350/1900	750/2380	880/2600	560	2000	
ΔON Resistance Between Any 2 of 4 Switches ΔRON	R _L = 10 kΩ*										
	+7.5	-7.5	±7.5	-	-	-	-	10	-		
	+5	-5	±5	-	-	-	-	15	-		
Sine Wave Response (Distortion)	+5	-5	5 p-p					0.4	-		
	R _L = 10 kΩ f _{IS} = 1 kHz								%		
Frequency Response Switch ON (Sine-Wave Input)	V _{DD} = +5 V _C = V _{SS} = -5		-5 p-p								
	R _L = 1 kΩ 20 log ₁₀ $\frac{V_{OS}}{V_{IS}}$ = -3 dB							40	MHz		
Feedthrough Switch OFF	+5	-5	-5 p-p					1.25	MHz		
	R _L = 1 kΩ 20 log ₁₀ $\frac{V_{OS}}{V_{IS}}$ = -50 dB										
Input or Output Leakage Current Switch OFF (Effective OFF Resistance)	V _{DD}	V _C = V _{SS}									
	+7.5	-7.5	±7.5	-	-	-	-	±100	μA		
	+5	-5	±5	-	-	-	-	±10x10 ⁻³	nA		

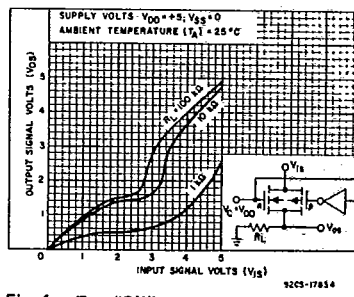


Fig. 4 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +5 V, V_{SS} = 0 V.

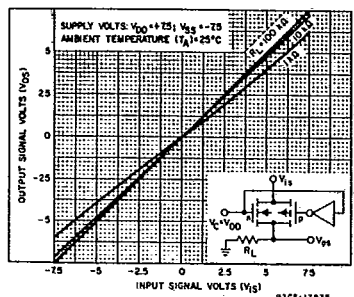


Fig. 5 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +7.5 V, V_{SS} = -7.5 V.

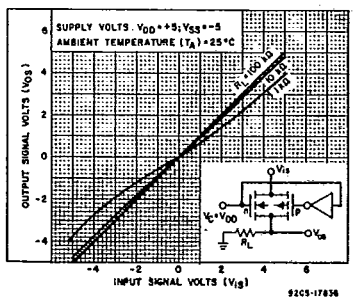


Fig. 6 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +5 V, V_{SS} = -5 V.

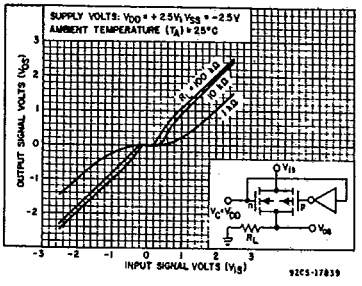


Fig. 7 - Typ. "ON" characteristics for 1 of 4 switches with V_{DD} = +2.5 V, V_{SS} = -2.5 V.

CD4016A Types

ELECTRICAL CHARACTERISTICS (Cont'd) $V_{SS} < V_i < V_{DD}$
Recommended DC Supply Voltage ($V_{DD}-V_{SS}$) .3 to 15 V

Characteristic	Test Conditions All Voltage Values are in Volts	Limits						Unit
		Values at -55°C, +25°C, +125°C Apply to D, F, K, H Packages Values at -40°C, +25°C, +85°C Apply to E Package						
		-55°	-40°	+85°	+125°	+25°C		
Typ.	Max.							
Crosstalk Between Any 2 of 4 Switches (f = -50 dB)	$V_C(A) = V_{DD} = +5$ $V_C(B) = V_{SS} = -5$ $V_{is}(A) = 5$ p-p $R_L = 1$ k Ω $20 \log_{10} \frac{V_{os}(B)}{V_{is}(A)} = -50$ dB	-	-	-	-	0.9	-	MHz
Propagation Delay (Signal Input to Signal Output) t_{pd}	$V_C = V_{DD} = 10$ $V_{SS} = GND$ $C_L = 50$ pF $V_{is} = 10$ Sq. Wave $t_r, t_f = 20$ ns	-	-	-	-	20	50	ns
Capacitance: Input, C_{i5} Output, C_{o5} Feedthrough, C_{i05}	$V_{DD} = +5$ $V_{CC} = V_{SS} = -5$	-	-	-	-	4	-	pF
Control (V_C)[†]								
Switch Threshold Voltage, V_{TH}	$V_{is} \leq V_{DD}, I_{is} = 10 \mu A$ $V_{DD} - V_{SS} = 15, 10, 5$	0.7min 2.9max	-	-	0.2min 2.4max	0.5min 1.5	2.7	V
Input Leakage Current, $I_{iL, max}$	$V_{is} \leq V_{DD}$ $V_{DD} = 15$	$\pm 10^{-5}$ typ; ± 1 max.						μA
Crosstalk (Control Input to Signal Output)	$V_C = 10$ (Sq. Wave) $t_r, t_f = 20$ ns $R_L = 10$ k Ω $V_{DD} = 10$	-	-	-	-	50	-	mV
Turn-On Propagation Delay, t_{pdc}	$V_{DD} - V_{SS} = 10$ $V_C = 10$ (See Fig. 25) $t_r, t_f = 20$ ns $C_L = 15$ pF $R_L = 1$ k Ω	-	-	-	-	20	40	ns
Maximum Allowable Control Input Repetition Rate	$V_{DD} = 10$, $V_{SS} = GND$, $R_L = 1$ k Ω , $C_L = 15$ pF $V_{CC} = 10$ (Sq. Wave) $t_r, t_f = 20$ ns	-	-	-	-	10	-	MHz
Av. Input Capacitance, C_1		-	-	-	-	5	-	μF

- * Limit determined by minimum feasible leakage current measurement for automatic testing.
- ▲ Symmetrical about 0 volts.
- For all test conditions.
- † All control inputs protected by COS/MOS protection network.

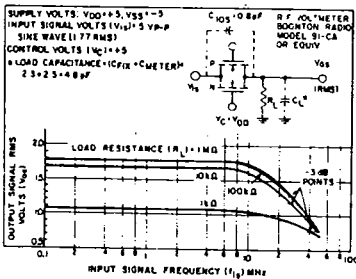


Fig. 11 - Typical switch frequency response - switch "ON".

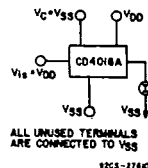


Fig. 12 - "OFF" switch input or output leakage current test circuit.

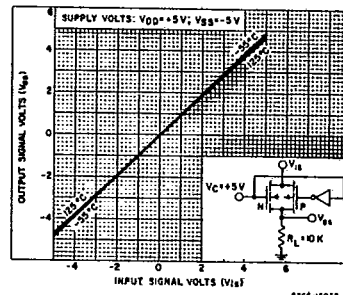


Fig. 8 - Typ. "ON" characteristics as a function of temp. for 1 of 4 switches with $V_{DD} = +5$ V, $V_{SS} = -5$ V.

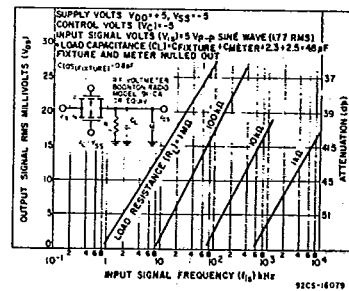


Fig. 9 - Typ. feedthru vs. frequency - switch "OFF".

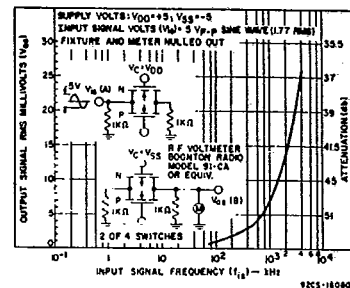


Fig. 10 - Typical crosstalk between switch circuits in the same package.

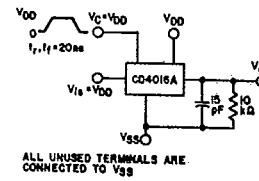
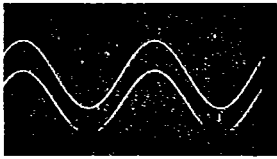


Fig. 13 - Test circuit for square-wave response.

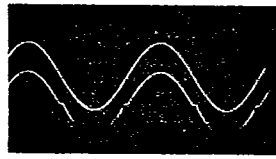
CD4016A Types



SCALE X = 0.2 ms/DIV Y = 2.0 V/DIV
V_{DD} = V_C = +7.5V, V_{SS} = -7.5V, R_L = 10KΩ
C_L = 15 pF
f_S = 1 KHz V_{IS} = 5V p-p
DISTORTION = 0.2%

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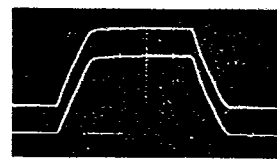
Fig.14 - Typical sine wave response of V_{DD} = +7.5 V, V_{SS} = -7.5 V.



SCALE X = 0.2 ms/DIV Y = 2.0 V/DIV
V_{DD} = V_C = +2.5V, V_{SS} = -2.5V, R_L = 10KΩ
C_L = 15 pF
f_S = 1 KHz V_{IS} = 5V p-p
DISTORTION = 3%

92CS-27614

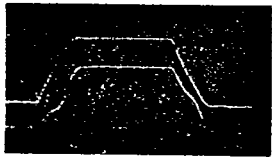
Fig.15 - Typical sine wave response of V_{DD} = +2.5 V, V_{SS} = -2.5 V.



SCALE X = 100 ns/DIV
Y = 5.0 V/DIV

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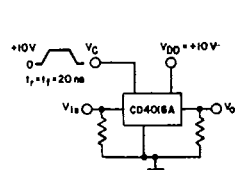
Fig.16 - Typical square wave response at V_{DD} = V_C = +15 V, V_{SS} = Gnd.



SCALE X = 100 ns/DIV
Y = 2 V/DIV

92CS-27617

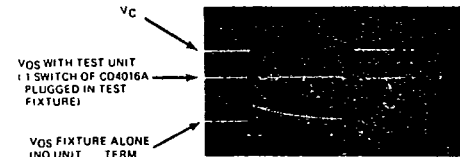
Fig.17 - Typical square wave response at V_{DD} = V_C = +5 V, V_{SS} = Gnd.



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

(a)

Fig.18 - Crosstalk-control input to signal output.



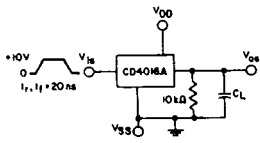
V_{IS} WITH TEST UNIT
(1 SWITCH OF CD4016A
PLUGGED IN TEST
FIXTURE)

V_{IS} FIXTURE ALONE
(NO UNIT TERM
S TO 3 OF SOCKET)

V_C = 10V PER DIV
V_{OS} = 0.2V PER DIV
t = 100ns PER DIV

92CS-27618

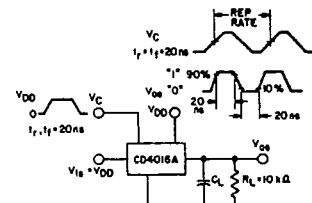
(b)



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

92CS-27619

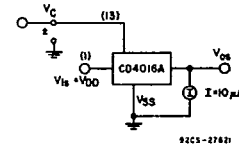
Fig.19 - Propagation delay time signal input (V_{IS}) to signal output (V_{OS}).



ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

92CS-27620

Fig.20 - Max. allowable control input repetition rate.



92CS-27621

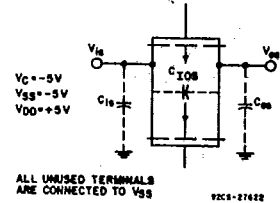
SWITCH THRESHOLD VOLTAGE IS DEFINED AS THE VOLTAGE APPLIED TO A TRANSMISSION GATE CONTROL WHICH CAUSES 10 μA OF TRANSMISSION GATE CURRENT.

Fig.21 - Switch threshold voltage.

MAXIMUM RATINGS, Absolute Maximum Values:

STORAGE TEMPERATURE RANGE (T _{stg})	-65 to +150°C
OPERATING TEMPERATURE RANGE (T _A)	
PACKAGE TYPES D, F, K, H	-55 to +125°C
PACKAGE TYPE E	-40 to +85°C
DC SUPPLY VOLTAGE RANGE (V _{DD})	
(Voltages referenced to V _{SS} Terminal)	-0.5 to +15 V
POWER DISSIPATION PER PACKAGE (P _D)	
FOR T _A = -40 to +60°C (PACKAGE TYPE E)	500 mW
FOR T _A = +60 to +85°C (PACKAGE TYPE E)	Derate Linearly at 12 mW/°C to 200 mW
FOR T _A = -55 to +100°C (PACKAGE TYPES D, F, K)	500 mW
FOR T _A = +100 to +125°C (PACKAGE TYPES D, F, K)	Derate Linearly at 12 mW/°C to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR T _A = FULL PACKAGE TEMPERATURE RANGE (ALL PACKAGE TYPES)	100 mW
INPUT VOLTAGE RANGE, ALL INPUTS	-0.5 to V _{DD} + 0.5 V
LEAD TEMPERATURE (DURING SOLDERING)	
At distance 1/16 ± 1/32 inch (1.59 ± 0.79 mm) from case for 10 s max.	+265°C

MEASURED ON BOONTON CAPACITANCE BRIDGE MODEL 75A (1 MHz)



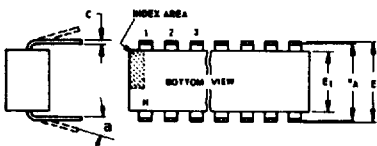
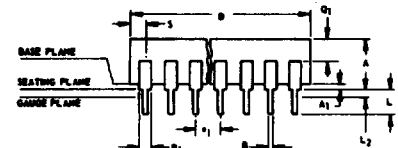
ALL UNUSED TERMINALS ARE CONNECTED TO V_{SS}

92CS-27622

Fig.22 - Capacitance C_{IOS} and C_{OIS}.

Dimensional Outlines

Dual-In-Line Welded-Seal Ceramic Packages



- NOTES:**
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L₂ when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N₁ is the quantity of allowable missing leads.

(D) SUFFIX (JEDEC MO-001-AD)
14-Lead Dual-In-Line Welded-Seal Ceramic Package

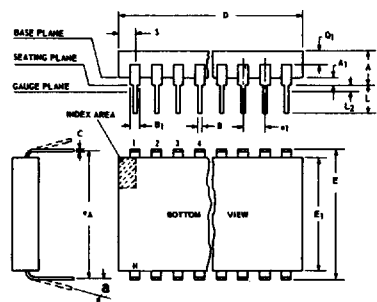
SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.160		3.05	4.06
A ₁	0.020	0.065		0.51	1.65
B	0.014	0.020		0.356	0.508
B ₁	0.060	0.065		1.27	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.770		18.93	19.55
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e ₁	0.100 TP		2	2.54 TP	
e _A	0.300 TP		2, 3	7.62 TP	
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	14		5	14	
N ₁	0		6	0	
Q ₁	0.050	0.085		1.27	2.15
S	0.065	0.090		1.66	2.28

92SS-4411R2

(D) SUFFIX (JEDEC MO-001-AE)
16-Lead Dual-In-Line Welded-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.160		3.05	4.06
A ₁	0.020	0.065		0.51	1.65
B	0.014	0.020		0.356	0.508
B ₁	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.785		18.93	19.93
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e ₁	0.100 TP		2	2.54 TP	
e _A	0.300 TP		2, 3	7.62 TP	
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	16		5	16	
N ₁	0		6	0	
Q ₁	0.050	0.085		1.27	2.15
S	0.015	0.060		0.39	1.52

92SS-4266R5



- NOTES:**
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L₂ when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N₁ is the quantity of allowable missing leads.

(D) SUFFIX (JEDEC MO-015-AG)
24-Lead Dual-In-Line Welded-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.090	0.200		2.29	5.08
A ₁	0.020	0.070		0.51	1.78
B	0.015	0.020		0.381	0.508
B ₁	0.045	0.055		1.143	1.397
C	0.008	0.012	1	0.204	0.304
D	1.15	1.22		29.21	30.98
E	0.600	0.625		15.24	15.87
E ₁	0.480	0.520		12.20	13.20
e ₁	0.100 TP		2	2.54 TP	
e _A	0.600 TP		2, 3	15.24 TP	
L	0.100	0.180		2.54	4.57
L ₂	0.000	0.030		0.00	0.76
a	0°	15°	4	0°	15°
N	24		5	24	
N ₁	0		6	0	
Q ₁	0.020	0.080		0.51	2.03
S	0.020	0.060		0.51	1.52

92CS-19948R4

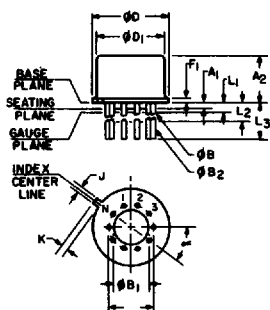
(D) SUFFIX (JEDEC MO-015-AH)
28-Lead Dual-In-Line Welded-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.090	0.200		2.29	5
A ₁	0	0.070	2	0	1.77
B	0.015	0.020		0.381	0.508
B ₁	0.015	0.065		0.39	1.39
C	0.008	0.012	1	0.204	0.304
D	1.380	1.420		35.06	36.06
E	0.600	0.625		15.24	15.87
E ₁	0.485	0.515		12.32	13.08
e ₁	0.100 TP		2	2.54 TP	
e _A	0.600 TP		2, 3	15.24 TP	
L	0.100	0.200		2.6	5
L ₂	0	0.030		0	0.76
a	0°	15°	4	0°	15°
N	28		5	28	
N ₁	0		6	0	
Q ₁	0.020	0.070		0.51	1.77
S	0.040	0.070		1.02	1.77

92CM-20250R2

TO-5 Style Package

(T) SUFFIX (JEDEC MO-006-AG)
12-Lead Metal Package



92CS-19774

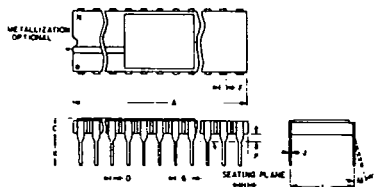
SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
a	0.230		2	5.84 TP	
A ₁	0	0		0	0
A ₂	0.165	0.185		4.19	4.70
φB	0.016	0.019	3	0.407	0.482
φB ₁	0	0		0	0
φB ₂	0.016	0.021	3	0.407	0.533
φD	0.335	0.370		8.51	9.39
φD ₁	0.305	0.335		7.75	8.50
F ₁	0.020	0.040		0.51	1.01
j	0.028	0.034		0.712	0.863
k	0.029	0.045	4	0.74	1.14
L ₁	0.000	0.050	3	0.00	1.27
L ₂	0.250	0.500	3	6.4	12.7
L ₃	0.500	0.562	3	12.7	14.27
a	30° TP			30° TP	
N	12		6	12	
N ₁	1		5	1	

NOTES:

- Refer to Rules for Dimensioning Axial Lead Product Outlines.
- Leads at gauge plane within 0.007" (0.178 mm) radius of True Position (TP) at maximum material condition.
- φB applies between L₁ and L₂. φB₂ applies between L₂ and 0.500" (12.70 mm) from seating plane. Diameter is uncontrolled in L₁ and beyond 0.500" (12.70 mm).
- Measure from Max. φD.
- N₁ is the quantity of allowable missing leads.
- N is the maximum quantity of lead positions.

Dimensional Outlines (Cont'd)

DUAL-IN-LINE SIDE-BRAZED CERAMIC PACKAGES



(D) SUFFIX
18-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.890	0.915		22.606	23.241
C	—	0.200		—	5.080
D	0.015	0.021		0.381	0.533
F	0.054	REF.	1	1.371	REF.
G	0.100	BSC	1	2.54	BSC
H	0.035	0.065		0.889	1.651
J	0.008	0.012	3	0.203	0.304
K	0.125	0.150		3.175	3.810
L	0.290	0.310	2	7.366	7.874
M	0°	15°		0°	15°
P	0.025	0.045		0.635	1.143
N	18			18	

92CS-27231R1

(D) SUFFIX
22-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	1.065	1.100		27.05	27.94
C	0.085	0.145		2.16	3.68
D	0.017	0.023		0.43	0.58
F	0.040	REF.	1	1.02	REF.
G	0.100	BSC	1	2.54	BSC
H	0.030	0.070		0.76	1.78
J	0.008	0.012	3	0.20	0.30
K	0.125	0.175		3.18	4.45
L	0.380	0.420	2	9.65	10.67
M	—	7°		—	7°
P	0.025	0.050		0.64	1.27
N	22			22	

92CS-25186R2

NOTES:

- Leads within 0.005" (0.13 mm)-radius of True Position at maximum material condition.
- Dimension "L" to center of leads when formed parallel.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).

(D) SUFFIX
24-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	1.180	1.220		29.98	30.98
C	0.085	0.145		2.16	3.68
D	0.015	0.023		0.39	0.58
F	0.040	REF.		1.02	REF.
G	0.100	BSC	1	2.54	BSC
H	0.030	0.070		0.77	1.77
J	0.008	0.012	3	0.21	0.30
K	0.125	0.175		3.18	4.44
L	0.580	0.620	2	14.74	15.74
M	—	7°		—	7°
P	0.025	0.050		0.64	1.27
N	24			24	

92CS-30968R1

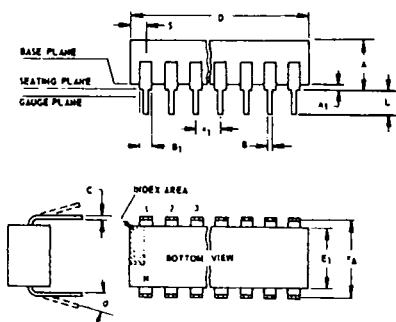
(D) SUFFIX
40-Lead Dual-In-Line
Side-Brazed Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	1.980	2.020		50.30	51.30
C	0.095	0.155		2.43	3.93
D	0.017	0.023		0.43	0.58
F	0.050	REF.		1.27	REF.
G	0.100	BSC	1	2.54	BSC
H	0.030	0.070		0.76	1.78
J	0.008	0.012	3	0.20	0.30
K	0.125	0.175		3.18	4.45
L	0.580	0.620	2	14.74	15.74
M	—	7°		—	7°
P	0.025	0.050		0.64	1.27
N	40			40	

92CM-27029R2

Dual-In-Line Plastic and Frit-Seal Ceramic Packages

(E) SUFFIX (JEDEC MO-001-AN)
8-Lead Dual-In-Line Plastic
(Mini-DIP) Package



SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A ₁	0.020	0.050		0.508	1.27
B	0.014	0.020		0.356	0.508
B ₁	0.035	0.065		0.889	1.65
C	0.008	0.012	1	0.203	0.304
D	0.370	0.400		9.40	10.16
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e ₁	0.100	TP	2	2.54	TP
e _A	0.300	TP	2, 3	7.62	TP
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.762
a	0	15	4	0	15
N	8		5	8	
N ₁	0		6	0	
O ₁	0.040	0.075		1.02	1.90
S	0.015	0.060		0.381	1.52

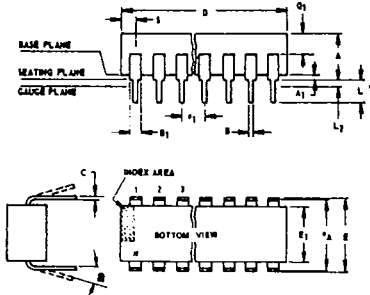
92CS-24026 R1

NOTES:

- Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder-dipped, the maximum lead thickness (narrow portion) will not exceed 0.013".
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L₂ when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N₁ is the quantity of allowable missing leads.

Dimensional Outlines (Cont'd)

Dual-In-Line Plastic and Frit-Seal Ceramic Packages (Cont'd)



NOTES:
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.

- When this device is supplied solder dipped, the maximum lead thickness (narrow portion) will not exceed 0.013" (0.33 mm).
- Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
- e_A applies in zone L₂ when unit installed.
- a applies to spread leads prior to installation.
- N is the maximum quantity of lead positions.
- N₁ is the quantity of allowable missing leads.

(E) and (F) SUFFIXES (JEDEC MO-001-AB) 14-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A ₁	0.020	0.050		0.51	1.27
B	0.014	0.020		0.356	0.508
B ₁	0.050	0.065		1.27	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.770		18.93	19.55
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e ₁	0.100 TP		2	2.54 TP	
e _A	0.300 TP		2, 3	7.62 TP	
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	14		5	14	
N ₁	0		6	0	
Q ₁	0.040	0.075		1.02	1.90
S	0.085	0.090		1.66	2.28

92SS-4296R3

(E) and (F) SUFFIXES (JEDEC MO-001-AC) 16-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A ₁	0.020	0.050		0.51	1.27
B	0.014	0.020		0.356	0.508
B ₁	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D	0.745	0.785		18.93	19.93
E	0.300	0.325		7.62	8.25
E ₁	0.240	0.260		6.10	6.60
e ₁	0.100 TP		2	2.54 TP	
e _A	0.300 TP		2, 3	7.62 TP	
L	0.125	0.150		3.18	3.81
L ₂	0.000	0.030		0.000	0.76
a	0°	15°	4	0°	15°
N	16		5	16	
N ₁	0		6	0	
Q ₁	0.040	0.075		1.02	1.90
S	0.015	0.060		0.39	1.52

92CM-15967R4

(E) SUFFIX 18-Lead Dual-In-Line Plastic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A ₁	0.020	0.050		0.508	1.27
B	0.014	0.020		0.356	0.508
B ₁	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D	0.845	0.885		21.47	22.47
E ₁	0.240	0.260		6.10	6.60
e ₁	0.100 TP		2	2.54 TP	
e _A	0.300 TP		2, 3	7.62 TP	
L	0.125	0.150		3.18	3.81
a	0°	15°	4	0°	15°
N	18		5	18	
N ₁	0		6	0	
S	0.015	0.060		0.39	1.52

92CS-30630

(E) SUFFIX 22-Lead Dual-In-Line Plastic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.155	0.200		3.94	5.08
A ₁	0.020	0.050		0.508	1.27
B	0.015	0.020		0.381	0.508
B ₁	0.035	0.065		0.89	1.65
C	0.008	0.012	1	0.204	0.304
D		1.120			28.44
E	0.390	0.420		9.91	10.66
E ₁	0.345	0.355		8.77	9.01
e ₁	0.100 TP		2	2.54 TP	
e _A	0.400 TP		2, 3	10.16 TP	
L	0.125	0.150		3.18	3.81
L ₂	0	0.030		0	0.762
a	2°	15°	4	2°	15°
N	22		5	22	
N ₁	0		6	0	
Q ₁	0.055	0.085		1.40	2.15
S	0.015	0.060		0.381	1.27

92CS-30830

(F) SUFFIX (JEDEC MO-001-AG) 16-Lead Dual-In-Line Frit-Seal Ceramic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.165	0.210		4.20	5.33
A ₁	0.015	0.045		0.381	1.14
B	0.015	0.020		0.381	0.508
B ₁	0.045	0.070		1.15	1.77
C	0.009	0.011	1	0.229	0.279
D	0.750	0.795		19.05	20.19
E	0.295	0.325		7.50	8.25
E ₁	0.245	0.300		6.23	7.62
e ₁	0.100 TP		2	2.54 TP	
e _A	0.300 TP		2, 3	7.62 TP	
L	0.120	0.160		3.05	4.06
L ₂	0.000	0.030		0.000	0.76
a	2°	15°	4	2°	15°
N	16		5	16	
N ₁	0		6	0	
Q ₁	0.050	0.080		1.27	2.03
S	0.010	0.060		0.254	1.52

92CM-22284R1

(E) and (F) SUFFIXES (JEDEC MO-015-AA) 24-Lead Dual-In-Line Plastic or Frit-Seal Ceramic Package

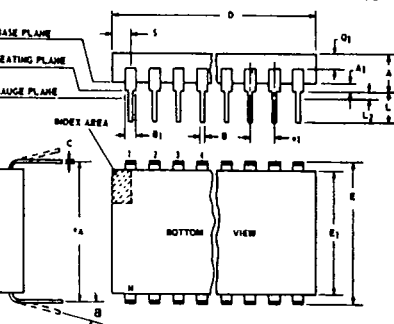
SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.250		3.10	6.30
A ₁	0.020	0.070		0.51	1.77
B	0.016	0.020		0.407	0.508
B ₁	0.028	0.070		0.72	1.77
C	0.008	0.012	1	0.204	0.304
D	1.20	1.29		30.48	32.76
E	0.600	0.625		15.24	15.87
E ₁	0.515	0.580		13.09	14.73
e ₁	0.100 TP		2	2.54 TP	
e _A	0.600 TP		2, 3	15.24 TP	
L	0.100	0.200		2.54	5.00
L ₂	0.000	0.030		0.00	0.76
a	0°	15°	4	0°	15°
N	24		5	24	
N ₁	0		6	0	
Q ₁	0.040	0.075		1.02	1.90
S	0.040	0.100		1.02	2.54

92CS26938R2

(E) SUFFIX 40-Lead Dual-In-Line Plastic Package

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.120	0.250		3.10	6.30
A ₁	0.020	0.070		0.51	1.77
B	0.016	0.020		0.407	0.508
B ₁	0.028	0.070		0.72	1.77
C	0.008	0.012	1	0.204	0.304
D	2.000	2.090		50.80	53.09
E ₁	0.515	0.580		13.09	14.73
e ₁	0.100 TP		2	2.54 TP	
e _A	0.600 TP		2, 3	15.24 TP	
L	0.100	0.200		2.54	5.00
L ₂	0.000	0.030		0.00	0.76
a	0°	15°	4	0°	15°
N	40		5	40	
N ₁	0		6	0	
Q ₁	0.065	0.095		1.66	2.41
S	0.040	0.100		1.02	2.54

92CS-30959



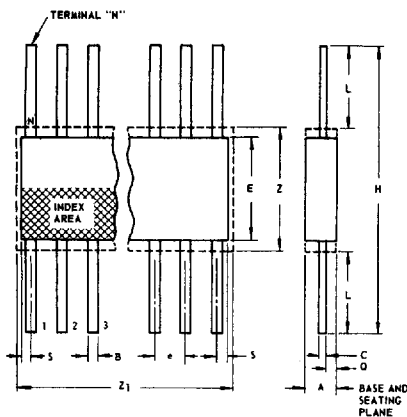
- NOTES:
Refer to Rules for Dimensioning (JEDEC Publication No. 95) for Axial Lead Product Outlines.
- When this device is supplied solder dipped, the maximum lead thickness (narrow portion) will not exceed 0.013".
 - Leads within 0.005" (0.12 mm) radius of True Position (TP) at gauge plane with maximum material condition and unit installed.
 - e_A applies in zone L₂ when unit installed.
 - a applies to spread leads prior to installation.
 - N is the maximum quantity of lead positions.
 - N₁ is the quantity of allowable missing leads.

T-90-20

Dimensional Outlines (Cont'd)

Ceramic Flat Packs

**(K) SUFFIX (JEDEC MO-004-AF)
14-Lead**



SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.008	0.100		0.21	2.54
B	0.015	0.019	1	0.381	0.482
C	0.003	0.006	1	0.077	0.152
e	0.050 TP		2	1.27 TP	
E	0.200	0.300		5.1	7.6
H	0.600	1.000		15.3	25.4
L	0.150	0.350		3.9	8.8
N	14		3	14	
Q	0.005	0.050		0.13	1.27
S	0.000	0.050		0.00	1.27
Z	0.300		4	7.62	
Z ₁	0.400		4	10.16	

9288-4300R3

NOTES:

1. Refer to JEDEC Publication No. 95 for Rules for Dimensioning Peripheral Lead Outlines.
2. Leads within 0.005" (0.12 mm) radius of True Position (TP) at maximum material condition.
3. N is the maximum quantity of lead positions.
4. Z and Z₁ determine a zone within which all body and lead irregularities lie.

**(K) SUFFIX (JEDEC MO-004-AG)
16-Lead**

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.008	0.100		0.21	2.54
B	0.015	0.019	1	0.381	0.482
C	0.003	0.006	1	0.077	0.152
e	0.050 TP		2	1.27 TP	
E	0.200	0.300		5.1	7.6
H	0.600	1.000		15.3	25.4
L	0.150	0.350		3.9	8.8
N	16		3	16	
Q	0.005	0.050		0.13	1.27
S	0.000	0.025		0.00	0.63
Z	0.300		4	7.62	
Z ₁	0.400		4	10.16	

92CS-17271R3

**(K) SUFFIX
24-Lead**

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.075	0.120		1.91	3.04
B	0.018	0.022	1	0.458	0.558
C	0.004	0.007	1	0.102	0.177
e	0.050 TP		2	1.27 TP	
E	0.600	0.700		15.24	17.78
H	1.150	1.350		29.21	34.29
L	0.225	0.325		5.72	8.25
N	24		3	24	
Q	0.035	0.070		0.89	1.77
S	0.060	0.110	1	1.53	2.79
Z	0.700		4	17.78	
Z ₁	0.750		4	19.05	

92CS-19949R2

**(K) SUFFIX
28-Lead**

SYMBOL	INCHES		NOTE	MILLIMETERS	
	MIN.	MAX.		MIN.	MAX.
A	0.075	0.120		1.91	3.04
B	0.018	0.022	1	0.458	0.558
C	0.004	0.007	1	0.102	0.177
e	0.050 TP		2	1.27 TP	
E	0.600	0.700		15.24	17.78
H	1.150	1.350		29.21	34.29
L	0.225	0.325		5.72	8.25
N	28		3	28	
Q	0.035	0.070		0.89	1.77
S	0	0.060	1	0	1.53
Z	0.700		4	17.78	
Z ₁	0.750		4	19.05	

92CS-20972